AMERICAN
DYESTUFF REPORTER

VOLUME XXII SEPTEMBER 25, 1933 NUMBER 20

Shrinkage of Cotton and Linen Woven Materials*

By G. H. JOHNSON

One of the most annoying problems faced by laundryowners, retailers, and textile manufacturers alike in the past has been the natural shrinkage that occurs during the ordinary washing of textile materials that have not been preshrunk at all or that have been only partially preshrunk. Furthermore, the subject of shrinkage has been very much misunderstood by many, with the result that considerable misinformation exists, particularly in the minds of the average consumer. It is because of the existence of so much misinformation that this paper has been prepared.

Causes of Shrinkage

IT is obvious that stretching during manufacturing is one of the major causes of shrinkage, if not the major cause. From the time a bale of cotton is opened on through the entire manufacturing process, including finishing, the fibers, then the yarn, and finally the cloth itself is being pulled lengthwise. For example, one authority[1] points out that a shrinkage in length is experienced when kier-boiling cotton textiles prior to mill bleaching. However, he agrees that kier-boiling does not serve as a preshrinking process, since the handling of woven fabrics afterwards in rope form results in the application of considerable tension. Quoting from Matthews on this point, "consequently, owing to the considerable tension under which the goods are placed, it will usually be found that the shrinkage caused in kier-boiling will be more than compensated for, and consequently the goods will show a stretching rather than a shrinkage."

Coupled with the effects of tension during manufacturing, is the natural contraction due to the textile fibers themselves. As a matter of fact, fibers that have been stretched beyond their elastic limit may be left permanently with less elasticity and decreased tensile strength. These changes in properties may be explained as follows: Fibers are considered as being made up of unit particles joined end to end. When stretched beyond their elastic limit (which hardly occurs during ordinary manufacturing) the unit particles making up a fiber are spaced differently and permanently.

Another textile investigator[2], when discussing shrinkage, writes as follows:

"There have been many complaints of late about excessive shrinkage after the first washing and *these complaints are quite justified.* To get to the bottom of the trouble, a short history of the developments of cotton goods manufacturing and the requirements of the finisher are necessary. When plain looms were used for weaving, the contraction of the warp amounted to from 5 to 10 per cent. Such cloths, if put through the regular finishing process without special stretching devices, would gain from 2 to 3 per cent[3]. The converters, who received the benefits of this gain, had become accustomed to such an average and usually considered the same in their price calculation. Subsequent improvement in looms, notably the automatic warp let-off, reduced the contraction of the warp from 1½ to 2%, and in most cases where goods from such looms are put through the finishing process without special stretching devices, the result is a loss in length, which is further aggravated by calendering and other means of stretching by the mill in the gray (unbleached) state and before finishing. The demands by converters for gains to which they had been accustomed forced the finishers to adjust their processes so as to *produce gain at the expense of quality* and appearance. *Such cloths will shrink unreasonably.* . . ."

*IMPORTANT NOTE: The remarks relative to shrinkage in this paper do not apply to wool. Wool felting is an entirely different problem.

[1] J. M. Matthews, "Bleaching and Related Processes," 1921.
[2] F. B. Voegeli, American Dyestuff Reporter, May 12, 1930.
[3] This 2 to 3 per cent gain means a 2 to 3 per cent contraction during washing.

Summing up, shrinkage results very largely from the fact that textiles are stretched in varying degrees during the entire manufacturing operation. Furthermore, since they are dried in a stretched condition, often in the presence of sizing, the yarns almost always maintain their length until they come in contact with moisture, as during the first washing. If the fabrics have been stretched only slightly during manufacturing, the contraction during washing will be equally slight. On the other hand, if textiles have been stretched excessively during manufacturing, contraction during the first washing will be serious. It was the recognition of this fact by certain progressive manufacturers that brought about the development of satisfactory preshrinking processes such as sanforizing, since it was soon realized that the logical point at which to prevent shrinkage was prior to laundering. As has been aptly said by J. C. Turrell, "Control of shrinkage is not the product of the inventive mind of the textile industry, it has been born of necessity—an insistent demand from the consuming public—and those who contend the public will not pay for serviceable qualities in washable textiles are applying the traditional thinking of their grandfathers in the industry. . . . The idea of the consumer accepting an explanation that some agency or restorative method outside the control of the textile industry is responsible for lack of control or shrinkage qualities in textiles is gone forever."

Shrinkage Facts

(a) *Shrinkage Varies with the Material*

Time and again it has been observed during plant as well as laboratory tests that the amount of shrinkage that develops in the case of cotton and linen woven fabrics depends largely upon the properties of the material itself. This fact is illustrated in Table I. In this test fifty samples of shirtings were measured, marked, laundered at one time, and remeasured. As shown by the table, even though the fifty samples were laundered together, the amounts of contraction that resulted varied with the fabric.

Table I
Shirt Shrinkages

Rates of shrinkage in inches per yard	Number of samples Warp	Filling
No shrinkage at all	—	9
Less than 0.5 inch per yard.....	7	14
From 0.5 of inch to 1 inch.....	8	11
From 1 inch to 1.5 inches.....	11	12
From 1.5 inches to 2 inches.....	11	1
From 2 inches to 2.5 inches.....	7	1
From 2.5 inches to 3 inches.....	6	2

Table II also illustrates the fact that the amount of contraction that develops during washing depends upon the fabric itself. In this test 14 measured samples of cotton toweling were soaked in a soap and builder solution at 140° F. for 30 minutes. After this period of soaking, the excess moisture was squeezed from the towels. The samples were not wrung or twisted in order to avoid stretching. After being freed from excess water they were again measured for length and width. The treatment that each test piece received was identical insofar as laundering was concerned. Any differences, therefore, that occurred under the circumstances must be ascribed to a difference in the shrinking properties of the towels themselves. It will be noted that, depending upon the sample, the warp shrinkage varied from 0.36 of an inch to 2.73 inches for each yard of original material. In this instance only two samples developed a filling shrinkage. In the case of a towel or a sheet, a few inches contraction in length is not especially serious. A similar shrinkage in a tailored article, however, frequently cannot be disregarded by a consumer.

Table II

Towel Sample	Warp shrinkage in inches per yard	Filling shrinkage in inches per yard
1	0.36″	0.50″
2	0.54	....
3	0.72	....
4	1.26	....
5	1.80	....
6	1.80	....
7	1.80	....
8	1.83	0.72
9	1.90	....
10	2.23	....
11	2.41	....
12	2.52	....
13	2.52	....
14	2.73	....

(*b*) *Moisture Must be Present for Shrinkage to Occur*

Research studies in numerous laboratories have clearly demonstrated that moisture is an important factor in shrinkage. Without moisture there is no shrinkage. Table III illustrates the part that water alone plays in the shrinkage of unsized or very lightly sized materials. Each measured sample was soaked in tap water at 65° F. without the addition of any supplies. There was no agitation or squeezing. After being soaked for 15 and 30 minutes in cold water only, until thoroughly saturated, the unsized samples developed the following rates of shrinkage:

Table III

Sample		Warp shrinkage in inches per yard	Filling shrinkage in inches per yard
Overall material ...	1	2.5″	1.1″
	2	2.4	1.0
	3	3.0	1.0
	4	3.0	0.9
	5	2.3	1.0
Seat Cover Cloth ...	1	2.8	...
	2	3.4	1.3
	3	3.5	1.8
	4	3.4	1.3
	5	2.3	1.1
	6	3.0	0.5
Cotton Dress Goods .	1	1.3	...
	2	1.6	...

These data clearly indicate how the presence of moisture permits fabrics, that have been dried in a stretched condition, to readjust themselves to their natural length. As will be seen later, a soaking test is not the equivalent of a laundering process. At the same time when excessively stretched cotton fabrics, such as the overall and seat cover materials shown in Table III contract from 2 to 3 or more inches per yard merely when being *soaked in cold water only,* it is difficult to understand how any laundering process can be expected to control or prevent shrinkage. Contractions, such as occur in Table III, result from the fabrics being stretched prior to laundering. Furthermore, if textile materials that have not been properly preshrunk prior to tailoring shrink excessively in a simple soaking process in cold water, it is apparent that the reason for shrinkage is anything but the laundering process that has been used.

In Table IV are illustrated the shrinkages that are obtained during a water-soaking treatment only and that secured when measured samples of the same cloths were laundered once with a colored cotton lot. In both cases the temperatures of the bath equaled 120° F. In one instance, four samples of cotton cloth were soaked for 30 minutes in water only without agitation or squeezing of any sort. In the other, the samples were laundered in a cotton formula for 55 minutes, using 3-inch suds and 8-inch rinse levels.

Table IV

Fabric	Shrinkage after soaking in water at 120° F. Warp	Filling	Shrinkage after one laundering at 120° F. Warp	Filling
1	4.0″	0.9″	4.5″	1.0″
2	1.9	0.2	2.6	0.2
3	2.0	1.0	2.1	1.5
4	2.8	0.9	3.4	0.9

It should be noted that a 55-minute washing with agitation has increased the warp shrinkage from 0.1 to 0.7 of an inch and the filling shrinkages from nothing at all to 0.5 of an inch. These data proved that agitation in the washer plus the addition of supplies have only a minor influence upon the rates of shrinkage of unsized or lightly sized materials and that moisture is the most important factor. As far as the four overall fabrics listed in Table IV are concerned, on an average 84.8% as much shrinkage occurred during soaking as during actual washing. Repeated tests have conclusively shown that approximately 65 to 85% of the total shrinkage takes place during soaking in the case of lightly sized and unsized materials. As a summary, if a fabric has any tendency to contract—in other words, if it has been stretched during manufacturing without being satisfactorily preshrunk afterwards—there is nothing that can be done during the first washing to prevent shrinkage from occurring. As has been shown before, the shrinkage will vary with the fabric.

(*c*) *The Effect of Sizing*

Although lightly sized and unsized cotton and linen fabrics shrink to a very marked degree in water alone, the same fact does not hold true for heavily sized materials. In Table V, for example, the shrinkages obtained with four heavily-sized shirt interlining fabrics are shown. Four measured pieces were allowed to soak in water at 100° F. for 30 minutes. The excess moisture was squeezed, but not wrung, from the samples. They were then air-dried over night at 75° F. and remeasured. Four corresponding samples were washed in a 4-suds formula and rinsed in 5 baths. They were then soured, extracted, and dried. The shrinkages obtained by both methods are shown in Table V.

Table V

Shrinkage of Heavily Starched Interlining Fabrics

Fabric	Soaking in water at 100° F. Warp	Filling	Commercial laundry washing Warp	Filling
1	0.7″	...	1.9″	...
2	0.5	0.9″	2.0	1.6″
3	0.3	0.3	2.1	0.3
4	0.7	0.3	2.5	0.3

From these data, using heavily sized materials, it will be seen that on an average only about 26% of the warp shrinkage obtained during laundering could be secured *in* a soaking test in comparison with the previously mentioned 65 to 85% for lightly sized and unsized fabrics. These facts indicate that more complete contraction does not occur until the heavy starch sizing is removed. Some shrinkage does develop in a soaking process, but this contraction does not nearly approach its greatest limits until soap and builder plus agitation have removed the sizing.

These data are of importance to shirt manufacturers as well as laundryowners, since interlining material in collars as well as the shirtings proper often require the adoption of suitable preshrinking methods. In other words, considerable care must be taken that heavily sized interlining materials are properly preshrunk as well as tailored or else wrinkles will develop in shirt collars after the first laundering, due to the interlining shrinking to a greater degree than the face fabric. This is one of the reasons why parchmentized interlining materials are sometimes used in the manufacture of shirtings.

(*d*) *The Effect of Temperature*

A common belief, that apparently has little scientific foundation as far as cotton and linen woven materials are concerned, is the contention that as the washing temperature is increased, the amount of shrinkage or contraction of cotton goods is increased. Research has proved that such is by no means the case, but rather that moisture is a far more important factor. In one test, for example, four samples of cotton overall material 18 inches square were prepared and squares of twelve inches marked off inside the larger area. Each sample was soaked in water for 30 minutes at one of the temperatures listed in Table VI. The test pieces were then air-dried and measured. A study of the data in this Table brings out the following general conclusions:

1. Regardless of the temperature used, considerable

shrinkage occurred in water only, all supplies being absent.

2. An increase in the temperature of the water used did not have a marked influence upon the rates of shrinkages.

Table VI

Temperature of water	Shrinkage in inches per yard 1 Warp	1 Filling	2 Warp	2 Filling	3 Warp	3 Filling	4 Warp	4 Filling
33° F. (ice water	3.9″	0.6″	1.7″	0.2″	1.7″	1.0″	2.6″	0.9″
80° F.	3.8	0.8	2.4	0.2	2.2	0.9	3.0	0.9
120° F.	4.0	0.9	1.9	0.2	1.8	0.8	2.7	0.8
212° F. (boiling)	4.2	0.9	2.1	0.2	1.9	0.9	2.6	1.0

Again it should be borne in mind that water was the only supply with which the material came in contact. Slight differences of one or two-tenths of a per cent are easily due to stretching the samples slightly more in one case than in another.

The same general experience was observed with different fabrics during other tests. One group of five measured overall samples was soaked in water only at 76° F. for 30 minutes without the addition of supplies. A second set was treated in boiling water for the same length of time.

Table VII

Sample	Shrinkage in inches per yard at 76° F. Warp	Filling	Shrinkage in inches per yard at 212° F. Warp	Filling
1	2.5″	1.1″	2.7″	1.0″
2	2.4	1.0	2.7	1.0
3	3.0	1.0	3.0	1.0
4	2.9	0.9	3.0	0.9
5	2.3	1.0	2.3	1.0

In view of such data, it is difficult to conceive how the temperatures used during washing have much, if any, effect upon increasing or decreasing shrinkage in the case of cotton goods. The same observations have been made with regard to linen summer washsuit material. Results such as these have caused the laundry industry to draw the conclusion that washing temperature is not an important factor. An increase in temperature does not necessarily mean an increase in the shrinkage of cotton or linen goods.

(*e*) *The Effect of Washing Supplies*

Just as it has been learned that an increase in the temperature of the water used has little, if any, effect upon the shrinkage of cotton and linen woven materials, so has it been observed that the effect of washroom supplies is negligible. This assertion is supported by the data contained in the following tables. In these tests measured samples of four different overall materials were immersed in solutions of various laundry supplies at low and high temperatures. After 30 minutes of soaking, they were allowed to air-dry, after which they were again measured. Agitation was entirely lacking. The tests were designed to determine the combined action of water, temperature, and laundry supplies upon shrinkage.

Table VIII illustrates the effect of soap and soda ash solutions in comparison with the effect of water alone. Table VIII-A shows the effect of using soap and caustic soda for greasy overall classifications while Table VIII-B deals with the salt-soda ash formula. Again it should be recognized that slight discrepancies are due to unavoidable differences in stretching the samples for measuring.

Table VIII
Soda and Soda Ash

Temperature	Shrinkage in inches per yard 1 Warp	1 Filling	2 Warp	2 Filling	3 Warp	3 Filling	4 Warp	4 Filling
80° F.	4.1″	1.0″	2.1″	0.2″	1.9″	1.0″	2.8″	1.0″
120° F.	4.2	0.9	2.1	0.2	2.1	0.8	3.0	0.9
212° F.	3.9	0.8	2.1	0.2	2.1	0.9	2.6	0.8
Average shrinkage in water only	4.0	0.9	2.1	0.2	2.0	0.9	2.7	0.9

Table VIII-A
Soap and Caustic Soda

Temperature	Shrinkage in inches per yard 1 Warp	1 Filling	2 Warp	2 Filling	3 Warp	3 Filling	4 Warp	4 Filling
80° F.	3.9″	1.0″	1.9″	0.1″	2.2″	0.9″	2.9″	1.0″
120° F.	3.8	0.9	1.8	0.1	2.0	1.0	3.0	0.9
212° F.	4.2	0.8	2.1	0.2	2.0	0.9	2.9	0.9
Average shrinkage in water only	4.0	0.9	2.1	0.2	2.0	0.9	2.7	0.9

Table VIII-B
Salt and Soda Ash for Oil Saturated Rags and Overalls

Temperature	Shrinkage in inches per yard 1 Warp	1 Filling	2 Warp	2 Filling	3 Warp	3 Filling	4 Warp	4 Filling
120° F.	4.2″	0.9″	1.9″	0.2″	1.8″	0.8″	2.6″	0.8″
175° F.	4.2	0.8	1.9	0.1	1.9	0.8	2.6	0.8
Average shrinkage in water only	4.0	0.9	2.1	0.2	2.0	0.9	2.7	0.9

A study of these data brings out the fact that on an average, washroom supplies, as applied to greasy work, including soap, soda ash, caustic soda, and salt, have no appreciable effect upon the rate of shrinkage of cotton cloth regardless of the temperature used. Whenever slight differences occur, they reasonably are due to experimental error caused by variations in stretching and samples when smoothing out wrinkles previous to measuring. Averaging the results in the preceding three tables, it is found that the shrinkage obtained in the case of samples treated

(Continued on page 584)

Wetting Agents in Textile Processing

II. ADSORPTION OF WETTING AGENTS BY WOOL

By HARVEY A. NEVILLE, CHARLES A. JEANSON, III, and ARTHUR L. SMITH*

Department of Chemistry, Lehigh University, Bethlehem, Pa.

(Continued from page 543, Sept. 11 issue)

AS POINTED out in Part I of this discussion, the possibility of using the new type of wetting agents in a given process and the economy of its use will depend upon the rate at which it is exhausted from solution by the textile material. To illustrate the importance of this factor the adsorption of two of these wetting agents from water solution by wool was determined over a wide range of pH values.

For these experiments a fine grade of virgin wool was thoroughly degreased by scouring with soap and sodium carbonate, rinsed with distilled water and air dried. It was kept at constant humidity to attain a moisture content of approximately 13 per cent. Samples of wool weighing 5 grams were soaked for one hour at 50° C. in 500 c.c. of the solutions of the wetting agents. The wetting agents used were the commercial products known as "Gardinol CA" and "Igepon T." Both are sodium salts, the former a sulfate of a higher alcohol[2] and the latter a sulfonate of a condensation product. The solutions contained 0.5 per cent of the wetting agent and were made acid or alkaline by the addition of hydrochloric acid or sodium hydroxide. The pH values were determined colorimetrically at the end of the soaking period by means of standard indicators.

The percentage exhaustion of the wetting agent by adsorption was determined, after removing the wool, by evaporating 100-c.c. portions of the solutions, drying the residue at 100° C. in an oven and weighing it. When hydrochloric acid or sodium hydroxide had been used to change the pH of the solution, this was carefully titrated and the weight of the salt formed was subtracted from the weight of the residue. This weight was also corrected for the weight of wool dissolved by the solution in each case. The actual proportion of wetting agent adsorbed by 5 grams of wool from 500 c.c. of solution was obtained by comparing the corrected weight of the residue with the weight of residue resulting from 100 c.c. of a solution of the wetting agent in which no wool had been soaked. The results, expressed as percentage exhaustion from solution, are represented in Fig. 3. Since the weight of

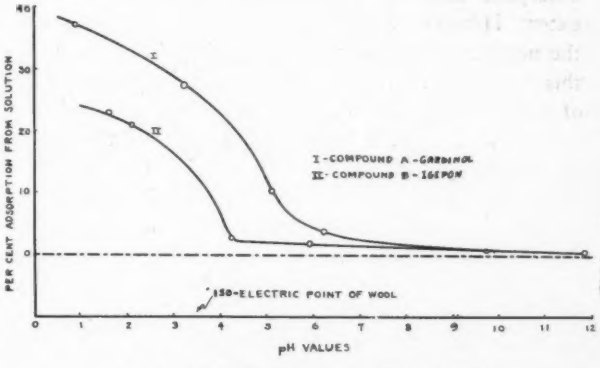

Fig. 3. Adsorption of Wetting Agents by Wool.

wool used in each experiment was twice the weight of wetting agent present in the solution, the adsorption percentages based upon the weight of wool will be one-half the values represented by the curves in Fig. 3. For example, at pH 1.5 the solution of compound B is 22.9 per cent exhausted; under these conditions the wool has adsorbed 11.45 per cent by weight of this wetting agent. The experiments show that these substances are adsorbed from solution by wool in appreciable amounts only in acid solutions and that the amount of adsorption increases with increase in hydrogen-ion concentration.

These results can be interpreted by considering the nature of the compounds in relation to the variation in

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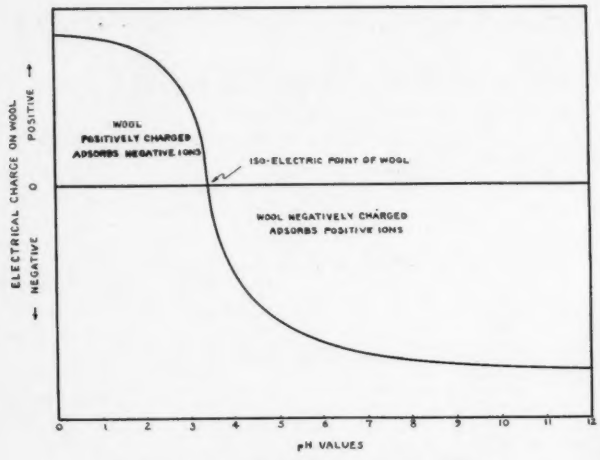

ELECTRICAL CHARGE ON WOOL
POSITIVE
NEGATIVE
WOOL POSITIVELY CHARGED ADSORBS NEGATIVE IONS
ISO-ELECTRIC POINT OF WOOL
WOOL NEGATIVELY CHARGED ADSORBS POSITIVE IONS
0 1 2 3 4 5 6 7 8 9 10 11 12
pH VALUES

Fig. 4. The Electrical Potential Curve of Wool.

the electrical charge of wool with change in pH as shown in Fig. 4. The wetting agents are sodium salts which, in water solution, produce surface-active anions containing a polar group and a long carbon chain. These negative ions are similar to the color ions of acid dyes and are similarly adsorbed by wool which bears a positive charge in acid solution. The iso-electric point of wool, as reported by Harris[8] occurs at pH 3.4. Some adsorption of the wetting agent occurs beyond this point, just as the adsorption curves of acid and basic dyes overlap to some extent. However, as the acidity increases beyond pH 3.4, the negative charge of the wool rapidly increases, and in this condition the wool repels the negatively charged ions of the wetting agent so that no measurable adsorption occurs in this region. It is generally recognized that soap is not selectively adsorbed from its solution (pH 10-11) by textile fibers; the explanation of this fact is obvious since the surface-active ion (or ionic micelle) of soap is likewise negatively charged.

The practical conclusion to be drawn from these experiments is that, although they are stable in acid solutions, the new types of wetting agents are so strongly adsorbed from solutions of high acidity that they can hardly be employed economically under these conditions. However, if it is found advantageous to operate a wet process within the pH range of 6 to 10, such wetting agents may well prove beneficial and deserve a fair trial. As already pointed out, at pH values beyond 10 soap competes with these new products and is generally equally effective except in hard waters.

While no compounds furnishing *positive* ions of high surface activity were available for testing, it may be predicted that such substances would, like basic dyes, be strongly adsorbed by wool from alkaline solutions and negligibly adsorbed from acid solutions.

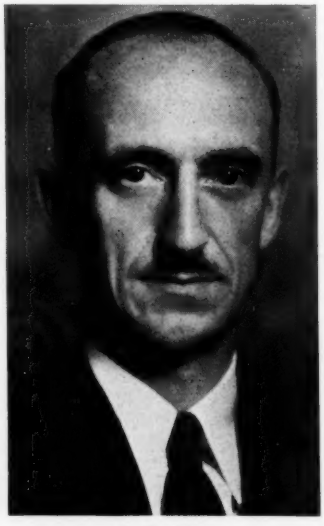
Reference

[8]Harris, M., Proceedings of the Am. Ass'n Tex. Chem. & Colorists. A. D. R., June 20, 1932, 233-237. Bur. Stand. J. Res., *8*, 779 (1932). Research Paper No. 451.

(*To be continued*)

Rochester Engineering & Centrifugal Corporation

For nearly fifty years the American Laundry Machinery Company has manufactured and sold certain special equipment for use by the textile industry, especially the knit goods, hosiery, and silk fields. The line of equipment has become so extensive that the officers of this company have felt that a separate company should be set up in order to still further specialize and concentrate on these textile activities.



R. C. CAINE

As a result the Rochester Engineering & Centrifugal Corporation with executive offices at 110 Buffalo Road, Rochester, N. Y., has been incorporated with the following officers: V. C. Kreuter, president and treasurer; Taylor Stanley, vice-president and secretary, and R. C. Caine, general sales manager.

Messrs. V. C. Kreuter and Taylor Stanley have been connected with the American Laundry Machinery Company for many years and are thoroughly familiar with the company's business. Mr. R. C. Caine was for years sales manager of the Specialty Department of the American Laundry Machinery Company. That department devoted its activities to the textile field. Mr. Caine is well known in the textile industry and will, as sales manager of the new company, be in even closer touch with the industry.

It will be the policy of the Rochester Engineering & Centrifugal Corporation to add constantly to the already extensive line of textile equipment and to develop such new products as will assist the textile industry to produce better goods more efficiently and economically.

"Rayon Dyeing and Finishing"

The regular installment of B. L. Hathorne's series of articles running currently in the REPORTER under the above title does not appear in this issue but will be continued in the October 9th issue.

Gravity Filter

The Hungerford & Terry Company of Clayton, N. J. are distributing copies of their bulletin No. 23 describing the Hungerford Air-Water-Wash Gravity Filter. Copies will be sent on request to interested parties.

PROCEEDINGS OF THE
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SEPTEMBER 25, 1933

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SPRING MEETING, PIEDMONT SECTION

THE Spring Meeting of the Piedmont Section of the A. A. T. C. C. was held in Greensboro, N. C., Saturday, May 13th, 1933, at the King Cotton Hotel.

The usual afternoon technical session was held with the following papers presented:

"Degumming, Dyeing and Finishing of Pure Silk Full-Fashioned Hosiery Containing Picot Edges, Stripes, etc., of Cellulose Acetate or Immunized Cotton"; by L. M. Boyd, of Scholler Brothers Company.

"Treatment of Water for Use in Boilers and Textile Plants"; by C. D. Blackwelder, of J. E. Sirrine & Company.

"Recent Developments in the Application of Fast Colors"; by S. H. Williams, of General Dyestuff Corporation.

"Some Color Shop Problems in Cotton Printing"; by J. H. Easley, of Rock Hill Printing & Finishing Company.

Following the presentation of the papers, a most interesting discussion was held, many of the members taking part in same.

The evening session was held during the banquet.

The Piedmont Section was very fortunate in having the National President, Dr. R. E. Rose with them on this occasion. Dr. Rose addressed them on the subject, "What the A. A. T. C. C. Means to the Textile Industry" and his remarks were most timely and interesting to all those present. The Piedmont Section is looking forward to having Dr. Rose with them again.

There being no further business, the meeting adjourned at 10:00 P. M.

Respectfully submitted,

HUGH PUCKETT, *Secretary.*

Correction Regarding Convention

In the report of the Thirteenth Annual Convention published in last issue it was erroneously stated that Dr. Robert E. Rose was present and spoke on the historical growth of the Association. This was due to an incorrect interpretation of the wire sent to us from Chicago. We wish to apologize to our readers and to Dr. Rose for this error. Dr. Rose was unable to attend the Convention because of ill health. It was Prof. Olney who gave the historical sketch. It was also incorrectly stated that papers by Sandridge and Harvey were cancelled at the Friday evening session. Dr. Harvey's paper was presented but the one by Johnson, originally scheduled for this session was not given.

Thirteenth Annual Convention

Gathering at the Banquet held Saturday evening, September 9th, Congress Hotel, Chicago.

Proceedings of the American Association of Textile Chemists and Colorists

Processing of Hosiery Containing Effect Threads*

By **L. M. BOYD**
Scholler Brothers Co.

THIS talk deals with the degumming, dyeing, and finishing of pure silk full-fashioned hosiery containing picot edges or stripes of cellulose acetate or immunized cotton. Full fashioned hosiery of this construction made its appearance on the market more than a year ago. Production is now on the increase, and quite a number of mills are producing merchandise of this kind. The proper dyeing of such a combination of fibers naturally caused the dyer many problems, and it was necessary that he do considerable research work to produce satisfactory results and first class merchandise.

We shall discuss first the treatment of the fabric containing cellulose acetate, as this is the most difficult to handle, and whatever methods apply to it give excellent results on immunized yarn. The hosiery may be knit of all pure silk with a ring or two and picot edge of cellulose acetate, or it may have a pure silk boot with mercerized sole and garter top with the cellulose acetate knit in the mercerized top. Both high luster and delustered cellulose acetate fibres are used. The high luster is the most difficult to handle, as there is always danger of delustering it, and it stains much more easily than the delustered one. Low luster cellulose acetates are more resistant to high temperatures, and, therefore, can be handled more easily both in degumming and in dyeing. The utmost care, however, must be exercised with both, as all acetate silks, when once saponified, will stain very readily, even with selected dyestuffs.

Most mills desire the acetate fibre to be left white, and this is possible with all colors, even black. Very striking contrasts and effects are produced. Others knit into the fabric white cellulose acetate, and require the dyer to dye it red, blue, green, or in fact any color, obtaining thereby two color effects. The benefits to the hosiery manufacturer are obvious, as he can give his customer any colored stripe and picot he desires, and not have to knit in that particular color beforehand.

Degumming

This is the most important operation on this class of merchandise. It is preferable to degum first, although some dyers are getting very good results with the split bath method. The split bath method has many advantages in the degumming of all grades and kinds of silk hosiery, and it may be well to give a brief outline, since perhaps some of you are not familiar with it.

Bath is prepared at the boil, one-half the amount of the necessary dsgumming agent is added, and then the goods are entered and kept at a slow boil for 20 minutes. Water, preferably warm or hot, is now turned into the machine and the bath is flushed over the top for a minute or two. The bath is then dropped, and a fresh bath made up, to which the other half of the degumming agent is added. Bring to the boil and add the necessary dyestuffs, and keep at a slow boil for 20 minutes, at which time Glauber's salt is added. Sample is taken at 40 minutes, and additions are made as usual.

The first bath in this method is really a very efficient scour, all tint, dirt, oil, etc., being removed. The remarkable thing about this method is the fact that no additional degumming agent is necessary. It saves time, steam and labor and gives better control of formulae without extra cost.

In degumming, all alkali must be avoided. Use only a neutral soap, or, better, a neutral boil-off oil. The type of boil-off oils, the alkalinity of which decreases on boiling, has been found best, as the continued action of even a very small amount of caustic or carbonated alkali will saponify acetate cellulose very quickly, especially at the elevated temperatures necessary for proper degumming and dyeing.

The alkali content of some softened waters is sufficient to saponify acetate cellulose, and in such cases the water must be neutralized before boiling-off and before dyeing, either with acid, preferably organic, acid sulfonated oils, or a protective agent that will neutralize the alkali as it is liberated. Several such oils and agents are available.

Experience has shown that raw waters of five grains hardness (85 ppm) or more require neutralization after softening on this class of work. The alkalinity of softened water is in direct proportion to the original hardness of the water, and 1,000 gallons of softened water, original

*Presented at meeting, Piedmont section, May 13, 1933.

hardness of 5 grains, will contain after thorough boiling approximately 12 ounces of anhydrous soda ash.

Zeolite converts calcium and magnesium bicarbonates into sodium bicarbonate. Sodium bicarbonate on continued boiling breaks down into soda ash, and this is what happens in boil-off and dye baths.

After being sure that the water is satisfactory, or having neutralized it, a standard method of boil-off can be followed, it being possible on this class of work to degum at a temperature of 210° Fahr. in one hour to one hour and fifteen minutes.

Dyeing

Here again the same precautions must be taken as to the alkalinity of the water. Being sure that the alkali is not too high, the dyeing can be conducted safely at temperatures of 205° to 210° Fahr., without danger of delustering or staining. The highest temperature possible with this method assures thorough penetration, level dyeing, and fastness,—essential requirements for hosiery dyeing.

New nets or those that have been thoroughly stripped must be used, as there is danger of staining the cellulose acetate from the dye that would be boiled out of the old nets, since perhaps the original dyeing was not made with selected dyestuffs. When the goods have been boiled-off first, it is preferable to renet before dyeing. This is not necessary with the split bath method.

Not all of the dyestuffs ordinarily used for hosiery dyeing are suitable for dyeing this class of work, as some of them will stain and tint acetate cellulose. A careful selection must be made. The dyestuff houses have studied the problem, and they can now give you a wide range of selected colors that will make it possible to match any shade on silk and cotton and not affect the cellulose acetate.

It has been found that using a high percentage of Glauber's salt is very beneficial, it being a well known fact that an excess of Glauber's salt retards to some extent the saponification of this fibre.

Rinsing after dyeing is of the utmost importance, and at least two warm waters at 85° Fahr., should be given. This is especially important on dark shades and black, as it clears the whites considerably.

Finishing

Fashion demands finished hosiery, principally low luster hosiery. First milady turned her stockings inside out to obtain a dull effect, then came crudely chemically treated low luster, regular tram twist hosiery, dull enough, but with no permanency to the finish. Then came high twist hosiery, grenadine, etc., then semi-high twist with a chemical treatment. Continued improvements were also made in the various finishes, one always striving for permanency, and today there are finishes on the market that will outlast the life of the stocking.

The chemical treatment has always been considerably lower in cost than that obtained by using high twist silk, and certain other advantages such as retention of shape and length are made possible. Pairing, folding, and handling are greatly facilitated. Finishing hosiery today requires as much care and attention as the dyeing does.

All soap, degumming oil, penetrants, etc., must be thoroughly rinsed from the goods before applying the finishes, as they retard absorption, and prevent uniformity and permanency.

Extraction after dyeing, shaking out and renetting is the ideal method, but somewhat costly. It does give greater efficiency and take-up, and more even results. It should be done in all cases where the goods have been run for quite a long time and have become tangled.

Finishes are usually applied in a bath at 85° to 90° Fahr., and a short bath should be used wherever possible, as it cuts down the amount of finish needed, and gives a better take-up.

A wide range of finishes are in use today to produce certain definite effects. The most important are delusterants, water repellents, spot proofings, fillers, softening agents to retain original feel, scroop effects, etc. Combination finishes embodying two or more of these effects are very popular.

Finishing has given the dyer considerable trouble as there is more or less change of shade, and the dyer must take this change into consideration when matching. Good practice is to keep two sets of samples, one before and the other after finishing.

Applying finishes requires the greatest care.

First, they must be thoroughly dissolved or emulsified, strained or filtered before being added to the machine. They should be added with the same precautions used in making dyestuff additions. In combination finishes, the same order of adding the different ingredients should be adhered to so that uniform results will be obtained. The proper lapse of time between additions of chemicals is also of great importance and must be carefully checked so that the proper absorption will have taken place before the next compound is added, thus allowing the chemical reaction to take place in the fibre and not in the bath or on the surface of the fabric.

These precautions prevent spots, chalkiness, streaks, unevenness and a host of other troubles.

We shall now discuss briefly the chemical composition of the various finishes used.

Delusterants—these products usually consist of inorganic salts such as compounds of aluminum, zinc, barium, calcium, titanium etc. Colloidal clays, talcs, and similar compounds are also used. The essential requirements of a delusterant is the fineness and stability of the precipitated particle.

Water repellents and spot proofings—These combinations contain principally metallic soaps, waxes, resins, etc.

Fillers—principally prepared glues, gelatines, starches, gums and various mixtures of the same.

Softeners—sulfonated castor and olive oils. Caution is necessary in the proper selection of the softener, as most softening agents either raise the luster, or are precipitated by the various delusterants and waterproofings, the principal cause of spots on finished hosiery.

It is a foregone conclusion that as silk finishes remain on the fabric, they must be made of the highest grade of materials, and must be non-poisonous and odorless.

Extracting

This is also an important operation, as the goods must be not too wet or too dry. Goods should be extracted immediately after being taken from the finishing bath. The time of extraction should be definite, and once determined should always be the same on the particular style and weight of goods. Extracting too dry will cause unevenness, especially if the goods are left for a considerable period of time before boarding. The hosiery dries out in spots, and the finish is drawn up from the wet portion by capillary attraction, thus causing marks, streaks, and uneven finishing. If left too wet, the finish will drain to the bottom and likewise will produce uneven goods. Goods should be boarded as soon as possible after extracting.

When it is necessary to let them lay overnight or over a week-end, the truck should be covered with a wet cloth to prevent the goods drying out.

Immunized yarns, as was stated before, are more resistant to the action of alkali than cellulose acetate, and further there is a wider range of dyestuffs that do not stain them.

If the precautions gievn for cellulose acetate, boiling-off, dyeing, and finishing are followed one can be assured of excellent results on this class of work.

Of course, the remarks made on finishing apply equally well to all kinds and grades of silk hosiery.

The Treatment of Water

For Use in Boilers and Textile Plants*

By **C. D. BLACKWELDER**
Chemical Engineer, J. E. Sirrine & Company, Consulting Engineers, Greenville, South Carolin

OF all the raw materials entering into the processes of boiling, bleaching and dyeing of textiles, water is by far the most important. The quality of water used in these processes is a matter of great importance. The use of an unsuitable water in such operations has in many cases resulted in faulty work. Water enters every stage of the processing, either as a vehicle for the chemicals used or as a solvent for the impurities which have been removed. The difference in the quality of work done by two different bleacheries is very often due largely to the composition of the water.

For many years the importance of the character of the water supply has been recognized. In fact this consideration has been one of the principal ones in controlling the geographic distribution of the textile industry, and we find as a result that our textile centers in this country are located in the Eastern and Southern States, where the water supplies are abundant and respond to purification treatment very readily. In recent years much progress has been made in the field of water purification for textile plants, with the result of improvement in water supplies and textile products. Due to these improved processes and equipment for water purification, the textile industry now is not so dependent on geographical location, in order to get a suitable water supply for use in processing the goods, as it has been in the past years.

The majority of the bleacheries take their water supply from rivers or creeks; some obtain their supplies from springs and wells. Practically all these raw water supplies require some form of chemical treatment and sedimentation and usually filtration, and in some cases softening. All these sources of water supply require treatment for control of alkalinity and hydrogen ion concentration.

I will not endeavor, in this short paper, to try to cover the various types of water treatment plants and the particular type necessary for waters of various compositions. Most textile men are familar with the usual type of filter

*Presented at meeting, Piedmont Section, May 13, 1933.
This paper was read by Mr. Feindal in place of Mr. Blackwelder who was unable to be present. We have a communication from Mr. Blackwelder in which he states that he will be willing to answer any questions sent to him by mail at Box 1516, Greensville, S. C.

plants found in connection with the textile mills that were built prior to six years ago. Since this time, many changes in the design of the plants and the application of chemical treatment have been made. The design of the filter beds and operating controls has gone through a period of improvement.

The average filter plant produces water that is practically free from turbidity and suspended matter and the water is fairly clear and sparkling. Due to the physical appearance of this water, it is rarely suspected of causing trouble in the processing of the goods. Frequently goods are damaged to a greater or less extent due to certain minerals and colloids left in the water but invisible to the unaided eye. Sometimes the raw water supply is polluted with sewage and trade wastes and, although the water is clarified, certain harmful elements have been left in it. There also may be present in the water certain spore-forming bacteria which are hard to destroy and often give trouble in the bleachery by producing stains, resists, peculiar odors and moulds.

A very small amount of suspended matter will cause trouble in a bleachery when the water is allowed to circulate on the cloth or yarn. It will cause a preciptate which results usually in a brownish stain. The process of bleaching and dyeing yarn in beam or package form is very sensitive to any suspensions and insoluble products formed by the chemical used and, therefore, water of the best quality is required. Often the bleacher and dyer or the dyestuffs are blamed for faulty work which is entirely due to the water.

Iron in its various forms is one of the greatest sources of trouble in the water supply. In a great many cases dyers blame their dyestuffs and chemicals for causing uneven dyeings when really the trouble is in the quality of the water.

Bleachers often hold their breath when removing the lid from the kiers, for they are anxious to know what kind of results they have obtained from the boil. Sometimes the boil is perfect but, due to circulating the water in the kier after the boil, suspended and colloidal matter is precipitated on the cloth. Very often these stains are caused by colloidal matter or organisms in suspension in the water. Very often too these water stains are confused with "kier stains," which are due to the precipitated pectin matter from the spent kier liquor. In a great many cases that have come under my observation, the kier and the goods therein have actually been forced to act as a filter plant. With a properly treated water supply, the majority of the stains and resists can be eliminated and a reduction in the quantity of chemicals used in processing the goods can be made. Returns and bleachery seconds will also be reduced.

Water with excess hardness should not be used for bleaching and dyeing. Hard water is not so good a solvent as soft water. It causes secondary reactions with the chemicals used in the various solutions with the result that more chemicals are required in the processing of a given quantity of goods.

Unsatisfactory results from the use of hard water are seen more often in the kier boiling and dyeing than anywhere else in the finishing plant. The calcium and magnesium salts, which constitute hardness, form insoluble compounds with the alkali and soap compounds used in boiling. These insoluble particles if left on the fiber become worked into the cloth and form a protective coating in spots which will not allow the goods to bleach properly. If the goods are dyed, these spots resist the penetration of the dye and cause light spots in the dyed goods. There are many textile assistants, detergents and wetting-out and leveling agents used that could be eliminated if the water were properly treated.

Many textile plants have well designed and efficiently operated filter plants Each year, more mill executives are realizing that the quality of water they are using is not the best. In order to get a better product at a reduction in manufacturing expense, they are modernizing their old water treatment plant or building an entirely new one

There are many water treatment plants in use today that are being called on to produce satisfactory water for processing but great difficulty is being experienced in getting the quality of water required. Very few of these plants that are not functioning properly were designed especially to treat the raw water being handled. The proper chemical and physical studies of the raw water should have been made and the results interpreted correctly and applied in the designing of the plant. There is no comparison in the exterior beauty of some of these plants and the quality of water being produced. In some of these plants that have come under the author's observation, the coagulants used were not the proper ones for the particular water and in some plants the coagulating chemicals were applied to the raw water incorrectly.

Some of the plants that have come under my observation for study and report were producing water of such poor quality that a considerable amount of the goods handled in the bleachery had to be processed the second time. The returns and bleachery seconds which were directly or indirectly caused by the composition of the water ran into many thousands of dollars per year. The production of delicate shades was impossible. Many of these hit-and-miss type water treatment plants were designed without sufficient mixing chambers, in which the raw water and coagulant should receive proper agitation before passing through the stilling wall into the coagulating or subsidence basin. In nearly every case the retention period in the coagulating basin was too short and the velocity through the basin too great. On checking up the cost of operating these plants, the chemical dosage was found to be excessive. This made the chemical treatment very expensive and increased the

objectionable mineral matter in the finished water. Due to improperly designed coagulating basins and filter beds, the filter runs were short which resulted in the use of a high percentage of the filtered water for back washing, thereby reducing the net output of the filter plant and increasing the pumping and chemical costs.

Many of these plants are not provided with proper equipment for controlling the alkalinity and hydrogen ion concentration of the filtered water. This is a very important subject and should receive proper thought by all owners of filter plants. Many of the modern finishing plants have recently installed the necessary equipment for controlling the alkalinity and hydrogen ion concentration of the filtered water. Perhaps all of you have observed "red water" runing from hot water spigots when they are first turned on. This red water generally contains iron, due to corrosion in the pipe lines and heaters, and is caused by the dissolved oxygen and carbon dioxide in the water. By controlling the hydrogen ion concentration or pH value of the water, this corrosion can be greatly retarded. Water lines supplying bleach and dye plants are very often badly corroded due to not controlling the pH value of the filtered water.

Particles of rust entering the bleach and dye liquors cause considerable trouble. The cause of this trouble can be practically eliminated by proper treatment of the filtered water before it leaves the water treatment plant.

Many of the so-called troubles in the bleachery and dye house can be avoided by proper treatment of the water supply. Proper study should be made of the particular water to be treated before designing a water treatment plant. Full knowledge of the processes and the chemical reactions involved in the bleachery and dye plant should be had before deciding on the chemical treatment of the water. Many tests should be made on the raw water over a period of several months, if possible. The tests should include complete mineral analyses as well as bacteriological studies. Studies and observations should be made of the chemical dosage required, size and texture of the floc formed by the coagulant, rate of floc formation and precipitation, nature of the colloids, turbidity and color removal, clarity of the water between the floc, and turbidity and color in the settled water. In addition to this, studies should be made on the corrosive properties of the water with a view of eliminating this evil.

After the water treatment plant is built and the operators are instructed in the operation, the plant must not be forgotten. The composition of the water in nearly all rivers and streams is changing constantly, due particularly to sewage and trade waste pollution. This being the case the filter plant operators periodically require technical services and instructions.

Although this paper does not cover the treatment and disposal of bleachery and dye waste waters, this is an increasingly important subject. Many of the bleaching and finishing plants have been subject to law suits due to pollution of streams and damage to properties. By proper treatment of these waste waters, it is possible to eliminate further pollution of streams and property damage. In many cases the cost of the necessary plant and treatment is very small in comparison with the results accomplished.

Ever since steam has been produced in quantities for industrial uses, boiler operators have been perplexed and annoyed by the formation of scale and deposits on the interior surfaces of the boilers. The application of chemistry gradually suggested means for entirely or partially preventing these deposits and also gave rise to a great variety of magic cure-alls which were used all too widely because of the users' general ignorance of chemical principles as applied to boiler water.

Until recently, low rates of evaporation and low furnace temperatures were prevalent, and deposits and scale on the interior surfaces of the boilers were not of much concern. If feed water treatment was not used or was not entirely effective, the deposits and scale were removed as well as possible by mechanical means. This procedure was expensive, to say the least.

Boiler water conditioning has become an important chemical engineering problem. Many of the present reagents were used in former days but not so intelligently. Due to lack of control and lack of knowledge of the chemical and physical phenomena of the boiled water and reagents inside the boiler, the best results could not be obtained. Now we must maintain certain sulfate-alkalinity ratios, and pH values must not fall below certain definite limits or corrosion is accelerated. Oxygen must be kept below prescribed limits. The total and suspended solids in the boiler water must be kept below certain definite limits, or the boilers will produce wet steam. This makes boiler operation a scientific procedure in which a fair knowledge by the operator of certain chemical reactions is necessary. The majority of the boiler operators are not familiar with pH, alkalinity, degassification, sulfate-alkalinity ratios and metal embrittlement, but the more up to date plants have engaged the services of specialists to impart this knowledge to their operators in a practical manner. By doing so they are eliminating deposits and scale in their boilers and superheaters; eliminating corrosion and deposits in their turbines, steam lines and heating units; and reducing their coal consumption, as well as the maintenance cost of their steam boilers.

In many plants by properly conditioning the boiler water it has been possible to operate old boilers at a higher rating, thereby producing more steam without the expenditure for additional boilers.

Boiler water conditioning requires simple pure chemicals, of definitely known composition, that can be purchased for a few cents per pound. The result of proper

selection of chemicals alone will not bring success; it is equally important to maintain the proper concentration of the selected chemical in the boiler water. In order to maintain the proper concentration automatically the installation of a very simple and inexpensive apparatus is required. The boiler attendants can learn in a few hours to make the simple tests required for proper control of the concentrations.

In this paper we have discussed only a few of the problems in water treatment for textile and boiler uses. There are many of you here today who are not interested particularly in these phases of water treatment and uses, but are interested in the subject of water for use in humidification or size mixing and for domestic use. Water for each of these uses is receiving more attention each year and some wonderful improvements and savings to the owners have been made.

The field of water treatment presents an almost endless series of problems, the solution of which depends, in nearly every case, upon detailed investigations. The fact that no iron-clad rules can be laid down makes the subject of water treatment a very interesting study. Each water must be studied to determine its particular characteristics and use.

Recent Developments in the Application of

Fast Colors on Cotton*

By **S. H. WILLIAMS**
General Dyestuff Corporation

IN SPEAKING of fast colors the following remarks will be confined to the four groups: vats, indigosols, naphtols, and rapidogens, and recent developments regarding their application on cotton.

Although a number of the colors in the four groups mentioned will not meet the rigid demands for guaranteed fast color materials, these groups represent the bulk of the types from which the trade makes selections in doing fast color work.

When we mention new developments, let us consider for a moment how few of the present types were at our disposal only a few years back and how important a new product or group of colors might be to the industry. One by one new colors were added to the list, each product calling for investigation as to its use in various plants, so that its advantages and limitations might be pointed out.

The early dyers, chemists and colorists were handicapped working with groups having a limited range. Therefore, they welcomed a new product that might help simplify their problems, whether it was a question concerning the working qualities of a product, or one involving the replacing of a color that was always on edge due to lack of the proper fastness.

An important step in the development of fast colors was the cotton printers' investigation concerning the application of vat colors. Only the pioneers in this field know of the numerous problems that confronted their successful application. The dyestuff manufacturers, quick to recognize a tremendous outlet for their products, immediately put research staffs to work in aiding the industry to apply these colors properly. They recognized the need for smooth, grit-free pastes and colors having the properties of fixing in the shortest possible time in an ager. The results are that today the colorist has at his disposal a wide range of products developed to meet these special requirements.

The majority of these new developments were not accidental, and colors analogous to our every-day, modern appliances are here because of research put to work in an attempt to make products having properties that would overcome some fault of the existing types. Mechanical equipment was improved by the same methods, and machinery manufacturers were quick to see the needs of the industry in producing suitable equipment with which to apply the new colors.

The producer of fabrics containing fast color effects has at his command today thousands of combinations from which to select the proper type for the right job. For this work on cotton the four groups mentioned come foremost into consideration.

Naphtols have already made marked strides in gaining

*Presented at meeting, Piedmont Section, May 13, 1933.

an important position in this field and it is the newer developments that have greatly enhanced the value of this line. The naphtols and their allied groups, the rapid fast colors and rapidogens, are striking examples of careful research.

The introduction of a new development almost immediately compels the progressive plant to investigate its possibilities in order to keep ahead or abreast of the keenest competition. A great number of the products may prove of no interest, or have characteristics that may prevent their adoption in a particular line, but in all cases they should be investigated if they are developments of research by reputable concerns.

In most cases a laboratory test will determine the actual value of a product and govern what measures should be adopted in arranging practical trials. It is often true that successful laboratory results fail when put into practice, but it is only through these methods that we learn of the best and discard the unsuitable types.

When we look back, we find the concerns that have continually carried out experiments in their respective lines the ones that are best informed regarding present day developments. The future, no doubt, has in store for us a number of drastic changes in color application and a short period of time may find our present methods and products obsolete.

Naphtols

Let us look over this group and see the wide range of products now available since the first Naphtol AS was put on the market. Two new products that fill a requirement not obtainable with the older types of this class are Naphtol AS-LT and Naphtol AS-ITR. They fill a need in producing reds, rose and pink combinations that are faster to light than the same shades produced with the older products. Naphtol AS-ITR coupled with the Fast Red Salt or Base ITR is an important combination for producing bright shades of pink on all classes of work.

Naphtol AS-ITR belongs to the substantive class and has very good affinity for cotton. For this reason it is particularly adapted for pressure machine dyeing as it can be salt rinsed to advantage. Since Naphtol AS-ITR is classed with the less soluble naphtols, piece goods to be dyed with this color are best impregnated on the jig.

Naphtols AS-LB

This naphtol adds to the range a product for producing pleasing brown shades which are fast to light, washing, and chlorine. It is also highly substantive and can be applied on all forms of equipment. For piece goods the control of the impregnation is more easily handled by applying on the jig, due to its fast exhausting properties. This naphtol is best dissolved hot with the addition of Igepon T or a good grade of sulfonated castor oil.

Naphtols AS-SG and AS-SR

Both these products produce very good blacks, ranging in tone from the green to the red side. They are welcome improvements over the older naphtol blacks made with the various naphtols coupled with the Black Salts or Bases.

A feature of great importance is their use as shading products, which eliminates a great many of the undesirable combinations that had to be resorted to when dulling naphtol shades. It is always better practice to shade with a naphtol if possible as repeated results are more easily checked. Fast color salts used for shading purposes have always been more or less troublesome because of the difference in coupling energy.

Naphtol AS-GR

This type produced the first green and proved after years of research that this field was capable of offering almost a complete range of shades.

The green made with this naphtol coupled with Fast Blue Salt BB or Base was a little too blue for the majority of present shades. However, it finds a useful place in shading naphtol blues to the green side, which is necessary often when matching standards produced with the Hydron Blue G types.

Concerning the application of naphtols, I will confine the following remarks to piece goods.

What factors determine the most suitable method of application for dyeing naphtols on piece goods? The first consideration should be given to the properties of the naphtol to be used. The character of the naphtol decides whether the product is suited for pad work or best applied on jigs. The more soluble types are in most cases the less substantive and, as in the case of padding direct colors, make suitable products for pad work. The stability of naphtol pad solutions in the concentrations necessary for this kind of work must next be considered. It can be seen readily that naphtols having the properties of the less soluble types, being highly substantive and poor in stability, would offer problems in working out pad solutions that would check over a long run.

The yardage to be dyed governs whether or not continuous dyeing enters into the question. Small lots can be handled as economically on the pads and jigs. Naphtolated material gives the best fastness to crocking when dried before developing but as this procedure requires special care, it is seldom resorted to for plain shade work.

The construction of the material is also a factor of great importance and in itself often decides whether the material should be padded or impregnated on the jigs. Heavy goods on construction hard to penetrate, having poor absorption, would give best results by the straight jig method Naphtols dyed on merecerized prepared cloth have a better finished appearance, especially on low carded counts. The mercerizing helps overcome the dead cotton which at times is very noticeable.

Diazopon A

Naphthol dyers have at their disposal today a product

that fills a long-felt want in the application of this group. Diazopon A finds its use in the developing baths whether fast color salts or bases are employed. It prevents the surface decomposition which oftentimes results in bad work. It keeps in suspension and very finely divided the surplus color lake that is formed in the dyebath. Being held in suspension, this loosely coupled matter is easily removed from the material. This is an important matter in any form of naphtol dyeing.

In diazotizing some of the bases it is often found that they are hard to wet out, but if first pasted with Diazopon they diazotize easily and produce developing liquors free from scum.

Rapidogens

From the various naphtols and bases were developed the rapid fast and rapidogen colors which are playing such an important part in cotton printing. The rapidogens, having a wider range than the rapid fast colors, are the newer developments and offer in some cases advantages over the AS prepare style and printing on the fast color salts. These colors are best dissolved with warm water, caustic soda and a suitable solvent recommended by the manufacturers of this group. After printing and drying, they are aged in acetic acid fumes.

Just as we have the rapidogens which are developments from the naphtols, so we have the indigosols, the water soluble products of vat colors. The manufacture of water soluble vat colors is truly a great step forward and the future should develop further interesting products along this line. A factor of no little importance today is that involving the combined uses of the indigosols and rapidogens in cotton printing.

It is the writer's opinion that the combined use of the rapidogens and indigosols in no way endangers the future and importance of the vat colors. No doubt the use of these products will play an important part in future printing of certain styles of fast colors. Their value will be based on the style, pattern and fastness demanded.

A successful method has been worked out recently whereby both these groups are developed in acid fumes, requiring only rinsing and soaping as an aftertreatment.

The enumeration of the technicalities covering this subject alone would require a great deal of time and as the time allotted this paper is limited, I can only mention the bright future ahead for these new developments.

Vat Colors

Regarding the application of vat colors, to my knowledge there have been no drastic changes in methods during this past year. Colors have been improved to meet the present requirements. Finely dispersed pastes are at the disposal of the pigment-pad dyer and colors with increased stability properties have been manufactured to meet the more rigid requirements of the continuous piece goods dyer.

In regard to the newer vat colors, I am sure all of you are familiar with the recent new types offered to the trade. Two products of importance are the Indanthren Greys BG and M. They offer shades that are fast to light in pale tones and can be applied on cotton in all forms from raw-stock to the finished piece.

Proceedings of the American Association of Textile Chemists and Colorists

Some Color Shop Problems in Cotton Printing*

By J. H. EASLEY

Rock Hill Printing & Finishing Co.

THE process of mixing colors for printing has in recent years been passing from what was once considered an art into what is now approaching the exactness of a science. It is the purpose of this paper to point out, in a more or less general manner, some of the problems encountered in color mixing today, hoping that as a result the chemists and colorists so vitally concerned will be inclined to discuss such matters, with the further result that the practices of color mixing may be put on a still more scientific basis.

In problems of color mixing, as in all other problems concerning the utilization of chemicals, the correct methods of procedure are not only the concern of the user of these materials (in this case the colorist, printer, and plant chemist), but they are also the problems of the manufacturer supplying the materials. Obviously if a manufacturer cannot suggest a suitable method of application for his product, the prospective user of such product remains only a prospect and never a consumer.

During the past year or two there have been presented to the textile industry, and to the textile printing industry in particular, a vast number of new dyestuffs and, in certain instances, entirely new types of dyestuffs. No longer can a color shop be successfully operated by certain rule-of-thumb methods which in years past might have proved adequate. Each new development brought out by the dyestuff and chemical manufacturer presents not one, but perhaps a hundred new perplexities to the plant that would take advantage of these new products. The manufacturers with their large research and application laboratories, and staffs of highly trained technicians can be and are of very great assistance in solving these difficulties. While in a sense these problems are theirs as much as those of the colorist, printer and chemist, after all it rests primarily with these men in the plant to work out the intimate details of application.

There have recently been put at the disposal of the man in charge of a color shop so many new developments in the way of dyestuffs that it is probably worth while considering some of the problems they present, bearing in mind the fundamental principles to which one must adhere and which must always be considered no matter what type of colors are in question.

For the sake of clarity we can separate the ingredients making up the majority of printing colors, regardless of the type of dyes used, into four major groups. Of course there are exceptions which might not readily fit into this classification, but in general these groups are:

1. Coloring matters.
2. Thickenings.
3. Solvents.
4. Reacting chemicals.

Taking up the first group, coloring matters or dyestuffs, we find it to contain a long list of relatively new products including the indigosols, rapidogens and other types in addition to the older types which have been known for a number of years. Up until comparatively recent years the colorist was not confronted with any particularly difficult problem in the selection of the type of color he would employ for any lot of goods to be printed. The printing order coming into the plant would specify either fast colors or commercial colors, and the colorist had just enough of these two classes to give him a fairly complete range of shades. Today, however, when a printing order for fast colors comes in, the colorist, if he is one who has availed himself of the more recent adjuncts to the range of fast colors, is required to select from these distinctly different types those which possess the maximum advantages. He must select, first, those colors which will produce the individual shades desired in the combination, second, those which will work satisfactorily together both chemically and physically, third, those which possess the necessary fastness requirements and, last, but of primary importance, those colors which will effect the greatest possible economy consistent with satisfactory quality in the fin-

*Presented at meeting, Piedmont section, May 13, 1933.

ished material. If the pattern in question is one involving even no more than three colors the problem is often quite difficult. It may be found that a certain color in the combination can be produced in vat colors most economically; perhaps the second could be more cheaply done in rapidogens or rapid fast colors, and the third, we might find, could be produced in indigosols to the best advantage, or if a black, then in aniline black. Further, if one of the colors in the combination is obtainable with a naphtol, there often arises the question whether the coverage in that particular color is sufficient to warrant the impregnation of the goods with the required naphtol prepare, or whether it would be cheaper to use an otherwise more expensive type which does not require the naphtol impregnation. Obviously all of these types cannot be employed in the same combination. If such a thing were attempted we would probably find that the indigosol color would be destroyed in the development of the vat color, the rapidogen color would be dulled, and the vat color would subsequently lose color value in attempting to develop the indigosol or rapidogen color. How then is the combination to be most economically run? It is certainly no easy task to decide. Each combination must be studied, all possible methods of producing the desired effect investigated, the relative costs of the various methods estimated, and finally the most economical method selected. What proves to be the best type to use for a certain combination may be entirely unsuitable for another combination even in the same pattern. Of course the easy way out from a standpoint of mental effort is to confine color shop operations to the use of as few colors and types as are absolutely necessary to produce a complete range of shades and to forget about all advantages that might accrue from having various types from which to choose. There are not many plants in such a favorable financial position that they can do this, however. Today keen competition and ridiculously low prices have driven everyone to the most rigid economy consistent with good quality, and in some instances, sad to say, quality itself has also suffered.

The problem then resolves itself into one of determining as nearly as possible the cost of producing each pattern and each combination in the pattern, not only with one group of colors, but with all sorts of combinations of various groups which from a practical standpoint might work satisfactorily together. This is certainly no easy task, but it is a task which cannot be shirked if the soundest basis of operation is to be attained.

I have dwelt at some length on the problem of selecting the proper type of dyestuff for a given job, the coloring matter being the most important ingredient of any printing paste. Upon the type of color selected of course depends the type of paste to be used, the solvents, if any, and reacting chemicals which must be employed in conjunction with the color; these four groups being, as pointed out, the major ingredients of the printing paste.

Thickenings

In discussing the gums, and thickenings in general, we enter upon a subject about which there is a wide difference of opinion. It is perhaps quite hopeless to expect that we shall ever have a thickening which will meet the varied demands of the many different types of colors found in the average progressive color shop today. A thickening, such as a British Gum, which will withstand the high alkalinity of a vat color, is quite unsuitable for such colors as the rapidogens and indigosols except in very small quantities. This is evidently due to the reducing action of such a highly converted gum upon these colors which are adversely affected by reducing agents. The most satisfactory products for these latter colors seem to be (1) a mixture of a pure starch, such as wheat or tapioca, with a proportion of slightly converted starches, or (2) a partially converted starch, or (3) a mixture of starch and gum tragacanth.

There have recently been introduced to the trade a number of different gums recommended for this type of work, and each colorist has probably adopted what he considers the most suitable. It is perhaps agreed by all, however, that there is still left considerable room for improvement.

Solvents

The number of satisfactory solvents for any particular color is rather limited and the problem of selecting the best one is not so difficult, although often many experiments are required before the proper proportions are hit upon. With vat colors which are printed in a high degree of dispersion, as distinguished from some of the newer types which are applied from solutions, no solvents are necessary. In the case of those colors which can be brought into true solution, however, the greatest economy from a standpoint of color value and highest efficiency in printing can only be obtained when the color itself is in a true state of solution. Pasting up these so-called soluble colors with a small quantity of water and/or solvent, and adding this to a printing paste with the expectation that the color will properly dissolve in the paste is, to say the least, taking quite a good deal for granted. It would seem more advisable to bring the color into a true state of solution before adding it to the paste, thus insuring maximum color value and guarding against the presence of insoluble matter. The chief objection to this is probably the fact that to get certain of the newer types of colors into a true solution requires considerable dilution with water and solvents. Thus in order to make up a finished printing color of six ounces per gallon it is necessary to add a half gallon of liquid containing the six ounces of dissolved color to a half gallon of paste, and, unless the paste is very thick to start with or will stand very high dilution, the resulting mixture will be too thin to print satisfactorily. This

is where the use of the most efficient solvent for the particular color in question is of prime importance.

It is not likely that any one solvent can be found to meet all the needs of the color shop, but the need is quite apparent for considerable work on the part of the dyestuff manufacturer, the solvent manufacturer or the plant chemists to determine the most satisfactory methods of forming stable solutions at relatively high concentrations, of the various colors which by some means can be brought into solution. Remarkable improvement in color value and running qualities of a color can be obtained by bringing it into such a state of solution.

Reacting Chemicals

With reference to the further group of ingredients that go into the make-up of a printing paste, namely, the reacting chemicals, there is not so much that can be said. There are certain specific ingredients that must be added in rather definite quantities. Their nature depends on whether we are considering vat colors, rapidogens, indigosols or any other of the list of available dyestuffs. Use of too much or too little of these chemicals is generally quite obvious as determined by the finished product.

One point might be brought out in closing in connection with the printing of vat colors. This is with reference to the quantity of glycerine employed. Glycerine may not be, in the true sense of the word, a reacting chemical in vat printing, in that it does not seem to enter into the reactions taking place in the ager. Its favorable effect appears to be due to its hygroscopic properties, the moisture which it carries being necessary as a medium in which the reducing and dyeing actions take place. It was found that the quantity of glycerine used in vat printing had a marked effect upon the color value of vat dyestuff, less than 6 per cent giving a marked reduction in color value while more than six per cent showed apparently little increase in color value over that obtained with the six per-cent glycerine. Further, when the glycerine concentration was carried much higher the tendency of the colors to mark off in the ager was quite apparent. It is expected that the optimum proportions of glycerine will not be the same for all dyestuffs. It is further expected that differences in ager conditions will bring about changes in the ideal glycerine content. However, the writer has had no occasion to reach any definite conclusion in this latter connection.

CALENDAR OF COMING EVENTS
Meeting, South Central Section,
Andrew Johnson Hotel,
Knoxville, Tenn., Sept. 30

PROGRAM AT ANNUAL CONVENTION

THE following is the program of papers and speakers as actually presented at Annual Convention held in Chicago, September 8th and 9th. It will be noted that there are several changes from the program which we originally published in our issue of August 28th. The papers are listed in the order of presentation.

Friday evening:

Illustrated lecture—"Chemistry in Merchandising" by B. H. Harvey, Director, Montgomery Ward & Co.

Saturday:

Report of the Research Committee by Louis A. Olney, Chairman.

"The Carbonization Process—A Study of the Effect of Sulfuric Acid on Wool" by Milton Harris, Research Associate of the A. A. T. C. C.

"Peroxide Bleaching—A Report of Progress" by H. G. Smolens, Buffalo Electro-Chemical Co.

"The Rayon Industry—A Quarter Century of Progress" by Harold D. W. Smith, A. M. Tenney Associates.

"A Century of Progress in the Wallpaper Industry" by J. G. Stott, Jr., Ciba Company, Inc.

"A Comparison of Methods for the Estimation of Small Amounts of Copper in Textiles" by Walter M. Scott, G. J. Esselen, Inc.

"The Relation between Tensile Strength and Orientation of Cellulose Fibers" by Wayne A. Sisson, University of Illinois.

"Chemical Constitution and Wetting Action" by W. Kritchevsky, Rit Products Co.

"Modern Theories of Sulfonated Oil" by Lloyd H. Davis, National Oil Products Co.

"Development in the Application of Fat Alcohol Sulfates" by Samuel Lenher, E. I. duPont de Nemours & Co., Inc.

"New Possibilities in the Lubrication of Textile Fibers" by Charles B. Ordway, Alabama Polytechnic Institute.

"Uses of Starch Products in the Textile Industry" by H. A. Crown, Corn Products Sales Co.

Banquet, Saturday evening:

John W. Eich, General Dyestuff Corp., *Toastmaster.*

Speakers: Louis A. Olney, Chairman, Research Committee.

W. H. Spencer, Dean of the School of Business, University of Chicago.

Gordon D. Pratt, Manager in Montreal, for Messrs. B. Laporte, Ltd., Luton, England.

Carl E. Bick, Chairman of the Mid-West Section.

Proceedings of the American Association of Textile Chemists and Colorists

UNEMPLOYMENT REGISTER

Members of this association, who are without employment, should forward to the secretary a statement as to their qualifications and experience. This information will subsequently appear on these pages with an identifying key number. Employers are also requested to file with the secretary any vacancies which may occur in their businesses.—A. Newton Graves, Secretary, care Franklin Process Company, Providence, R. I.

Key: A—Laboratory and research; B—Dyeing or printing; C—Finishing; D—Sales; E—Instruction; F—Executive

NOTE. Persons who have obtained employment should notify the secretary at once. Prospective employers may file vacancies either with the secretary or the AMERICAN DYESTUFF REPORTER.

A-2

Education—B.T.C., Lowell Textile Institute, 1932; also course in shorthand and typing.

Experience—None to date, interested in quantitative analysis, experimental dyeing, color matching, dye testing and dye identification. Ability to learn quickly and will go anywhere. 23 years old, single.

A-B-1

Experience—Over twenty-years' experience in the laboratories of various chemical manufacturers, four months' experience as second hand in dye house, familiar with all types of dyes and fibers. Thirty-nine years old. Will supply references.

A-B-2

Education—Lowell Evening Textile School, 1917.

Experience—Five years' experience in hosiery dyeing, full fashioned hosiery of silk and cotton and silk, also men's hosiery containing rayon, wool, cotton and celanese. Several years experience in laboratory work. Has also had experience in jig-dyeing of cotton piece goods, slub and top dyeing.

A-B-3

Experience—Wide experience in several of the best print works in New England as plant chemist and application chemist. Has had practical experience in the supervision of several departments and in the development of processes. References furnished.

A-B-C-1

Education—Graduate Industrial Chemical Engineer, Pratt Institute—1911.

Experience—One year as plant control chemist, 4 years as laboratory chemist with gas company, 13 years as plant chemist with bleaching, dyeing and finishing plant. (Rayon and cotton piece goods). Formulated processes and put them into plant operation, 1 year as chemist and demonstrator for dyestuff company, 1 year as superintendent colorist with print works printing linen and rayon, 1 year as director of testing laboratory for national dry goods concern.

A-B-E-1

Education—B.S. in chemistry at C.C.N.Y. Working now on M.A. at Columbia.

Experience—7 years as dye tester and color matcher for dye manufacturer; 6 months skein silk and rayon dyer; 4 years textile chemist and dyer for cotton finishing concern; 2 months boss bleacher and 4 years as teacher of organic chemistry and dyeing. Age 38, single.

A-E-1

Education—Ph.D., Univ. of Illinois, studied chemical engineering at Columbia, licensed chemical engineer, New Jersey.

Experience—10 years' experience teaching in colleges, subjects included chemical and textile subjects. Has had broad experience in industrial work including experience in testing materials, research and consulting. Will go anywhere; references.

A-E-2

Education—B.T.C., Lowell Textile Institute, 1933.

Experience—Assistant instructor in chemistry, Lowell Textile Institute. Member of scholastic honorary fraternity.

B-1

Education—Educated and trained in chemistry and calico printing in Glasgow, Scotland.

Experience—Has been with large print works as colorist for 13 years producing first class work on cotton, rayon, wool and silk fabrics. References.

B-2

Experience—Boss dyer with one firm for 18 years, divisional supt. at print works for 1 year, in charge of processing and dyeing of cottons and rayons at large bleachery for 6 years. Prefers bleachery in East but will go anywhere. References.

B-3

Experience—Foreman piece dyer for the past 21 years. Can dye the following; celanese, rayon, cotton backs, wool, silk and mixed fabrics. Has knowledge of finishing and laboratory work.

B-6

Education—Graduate R. I. School of Design.

Experience—5 years in bleachery, 7½ years as assistant dyer, 2 years as boss dyer and 3 years as superintendent of dyeing and finishing. Married, 33 years old. References.

B-7

Experience—4 years as assistant to manager in ribbon mill; 2 years as boss dyer on veils, chiffons and silk skeins; 5 years as boss dyer on ribbons and skeins (cotton and silk); 7 years as boss dyer on spun silk (pure dye and fast) resisted colors; last 12 years as hosiery dyer on silk and cotton, silk-cotton, rayon or wool. 50 years old, married. References.

B-8

Education—Chemistry and Dyeing Department, Philadelphia Textile School.

Experience—Eleven years experience as chemist and boss dyer on the following: woolen, worsted and cotton yarn; woolen, worsted and union piece dyes on both ladies and men's wear; wool, cotton, shoddy and mohair raw stock. Age 33, married, will go anywhere. References.

B-9

Experience—Hosiery dyer with fifteen years' experience on high grade silk hosiery; familiar with all types of machines. Age 43, married. Will go anywhere. References furnished.

B-D-F-1

Experience—Has held positions as general superintendent of a print and dye works and a finishing company; held a position as boss dyer in a bleachery for 6½ years and as a colorist on 11 printing machines for 3½ years; has held a position as boss dyer for 6½ years with a finishing company and received general training for 3½ years; and has also been dyer in a mill dyehouse. Desires position as superintendent, colorist, dyer or salesman and solicitor.

D-1

Education—Graduate textile course, 1911, Georgia School of Tech.

Experience—Has had experience in all branches of the textile industry but chiefly in sales work. Was at one time in the dyestuff business and later in hosiery manufacturing. Prefers Middle Atlantic or southern states.

F-1

Education—Textile Institute, Alexander Hamilton Inst., Extension work at Brown Univ., working knowledge of German.

Experience—Has had executive departmental work with all types of textiles manufacturers. Acquainted with all types of textile machinery, dyestuff application, laboratory practice, cost methods, and checking methods and processes. References.

13th ANNUAL CONVENTION

A complete stenographic record of papers presented and discussions occurring at the Annual Convention in Chicago on September 8th and 9th will appear in forthcoming issues of the Reporter.

AMERICAN
DYESTUFF
REPORTER

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Published biweekly by
HOWES PUBLISHING CO., INC.
440 Fourth Avenue, New York City

A. P. HOWES, President
M. D. REESER, Secretary
H. F. CRAWFORD, Treasurer

Subscription price: $5.00 per year; Canadian $6.80; foreign $6.00

Vol. XXII September 25, 1933 No. 20

EMPLOYMENT IN AUGUST

ACCORDING to data collected by the Bureau of Labor Statistics of the U. S. Department of Labor there was an increase of 6.4 percent in factory employment during August as compared to July. The August employment index was 71.6 as compared to 67.3 in July. The index number is arrived at by using 1926 as a base year and the average of the twelve monthly indices of employment and payrolls during that year is represented by 100. The manufacturing payrolls increased 11.6 percent during the month of August, the index number having risen from 46.5 in July to 51.9 in last month. A comparison of employment during August 1932 and the same month of this year shows an increase of 27.9 percent while payrolls increased 43 percent. This shows that although payrolls have increased to a greater extent during the past year than have the corresponding employment figures, a comparison with the base year, 1926, shows that the level of wages for the present are still considerably under par. This is only to be expected when we consider that prices in 1926 were substantially higher than they are at the present time.

It is interesting to note that August was the fifth consecutive month in which increases in employment and payrolls were shown and that during August the number of industries showing increased employment was 81 out of a total of 89 surveyed. It is explained that the average increase of employment from July to August in the last ten years has been 0.2 percent and 1.5 percent increase in payrolls. The increases for August of 6.4 percent in employment and 11.6 percent in payrolls are of unusual proportions and must be due to some influence other than natural seasonal trends. Some would lead us to believe it is caused by the natural progress of industrial recovery in effect and others claim that it is due largely to the adoption of NRA codes by many establishments. Just how much is due to the functioning of the NRA codes and how much is due to natural recovery tendencies is unable to be determined. If the NRA codes were not in effect we could say that it was due entirely to recovery long overdue but inasmuch as the codes are in effect we must take them into consideration when we consider the increases in employment and payrolls.

Among the 81 industries reporting increases for August the largest increase was a seasonal gain of 55.2 percent in the beet sugar industry. Industries reporting an increase of more than 20 percent included the confectionery, millinery, textile machinery, and typewriter. It is surprising to note that the textile machinery industry showed such a large increase inasmuch as we have been given to understand by some concerns in this business that the operation of the textiles codes has tended to cut down on their sales due to the restrictive nature of some of the codes in regard to increasing productive machinery. Evidently there has been considerable replacement of obsolete or unproductive machinery and of course there are considerable orders on hand which were placed in advance of the effective dates of code operation.

Among the other major industries reporting increases in employment were included the following which are of particular interest to textile readers: silk goods, cotton goods, dyeing and finishing textiles. The rayon industry reported an increase of 12.3 percent and the chemical industry indicated an increase of 10,3 percent.

PRODUCTIVE MACHINERY

OF particular interest to machinery producers will be the remarks of A. W. Robertson, chairman of the board of the Westinghouse Company. He praised the recovery measures as having produced a feeling of optimism but questioned the advisability of limiting the output of production machinery and of restricting the use of improved production methods as a means of spreading employment. He said in part:

"Let us stop to think of the full significance of these things. People who follow similar courses of action (i. e., voluntarily agree not to change) cannot grow and cannot progress. Such a course of action followed by all the people would tend to stagnation and death in all our economic life, because, while we would probably have change, it would not be the change of growth and progress but the change of death and decay.

"What a tragedy! And yet millions of our fellow-citizens are planning a static life deliberately in the thought that they are doing right. It means the death of America as we know it if we as a people cease to change —to grow—to progress."

Directory of Commercial Textile Testing Laboratories

Realizing the growing need for a single list of all commercial textile testing laboratories in the United States, the Textile Foundation has prepared and published such a list. This list is sub-divided into two headings, (1) Commercial Textile Testing Laboratories, (2) Educational Laboratories. In group 1, 63 and in group 2, 25 different laboratories are mentioned.

We believe that this list of textile testing laboratories will be a useful reference book to all establishments manufacturing or consuming textile materials.

A complimentary copy may be secured by applying to Edward T. Pickard, The Textile Foundation, Commerce Building, Washington, D. C.

SHRINKAGE OF COTTON AND LINEN WOVEN MATERIALS

(Continued from page 564)

with laundry supplies is no greater than that secured with water alone.

Table IX
Shrinkage in inches per yard

	1 Warp	1 Filling	2 Warp	2 Filling	3 Warp	3 Filling	4 Warp	4 Filling
Water only	4.0″	0.9″	2.1″	0.2″	2.0″	0.9″	2.7″	0.9″
Water plus supplies	4.0	0.9	2.0	0.15	2.0	0.9	2.8	0.9

In other words, the presence of washroom supplies in actual laundering has little if any bearing upon the amount of shrinkage obtained. Supplies assist in the removal of dirt and because of their lowering effect upon surface tension undoubtedly assist in thoroughly wetting out textile materials with which they come in contact. However, it cannot be said that the shrinkage of any given cotton or linen woven fabric will be increased or decreased with the use of a specific supply.

(f) Effect of Washing Processes Used

When laundering woolens, research and experience have taught the laundry industry the necessity for modifying the washing formula in an effort to reduce felting. For instance, the washing temperature for woolen loads is kept under 100° F. Special wool washing equipment has been developed. Just as short a washing formula as possible is used in order to reduce agitation. High water levels are used in all sudsing and rinsing operations for the same purpose. In addition, a wool cylinder washer is stopped during draining and filling periods.

In the case of cotton and linen wash goods, however, such factors as temperature, washing time, and reduction of agitation have been found to be of no importance in reducing shrinkage. Cotton fabrics, for example, contract just as much on the whole in a cold water formula as in a typical white formula where a temperature of 170°-180° F. may be reached during the final rinses. The data in Table X prove that it makes very little difference, so far as shrinkage is concerned, whether cotton woven materials are washed at low or high water levels. The same observations have been made for linen materials. One set of overall samples, composed of four different materials, was washed twice with small loads of woolens in water having a temperature of 80° F. The water levels used were high, as is customary for woolens, equaling 12 inches for both suds and rinses in a 30-inch diameter machine. One 10-minute suds and three 3-minute rinses were used. The washer was stationary during draining and filling periods. Every precaution was taken to handle the pieces just as if they had been composed entirely of wool.

A second set of samples was then washed twice at 120° F. with three 10-minute suds and four 5-minute rinses. This meant that the actual washing time in this instance was fully two and one-half times greater than that of the first experiment. Three-inch suds and 8-inch rinses were used in a 42-inch diameter washer, compared with the 12-inch levels of the woolen formula in a 30-inch machine. After two washings and dryings, the following shrinkages were recorded:

Table X
Comparative Shrinkages in Woolen vs. Cotton Formulae

	Shrinkage after 2 washings with a woolen formula at 80° F. (20 minutes) Warp	Filling	Shrinkage after 2 washings with a cotton formula at 120° F. (55 minutes) Warp	Filling
1	5.3″	1.7″	5.7″	1.8″
2	4.1	0.5	4.3	0.8
3	2.2	1.5	2.2	2.0
4	3.8	1.7	3.6	1.5

The following facts are brought out by this series of power laundry tests:

1. During two washings, practically as much shrinkage occurred when samples were washed in cold water and with high water levels as when they were laundered at 120° F. at low water levels. Varying amounts of agitation or squeezing action did not affect the shrinkage seriously one way or the other.

2. Practically as much shrinkage or contraction occurred during two 20-minute washings as during two 55-minute washings.

In conclusion, it makes very little difference what type of washing formula is used for cleaning cotton and linen materials. Sufficient agitation is secured even in a low-temperature woolen formula to bring about serious shrinkage, unless the fabric has been properly preshrunk and tailored.

(To be continued)

The Dyer's Responsibility

By G. L. ATKINSON

THE dyer is still held responsible for many faults, which occur or appear after the fabric has been dyed, this being particularly the case with the lighter weights of dress goods for ladies' wear, which include poplins, repps, charmelines, light serges, etc., and which incidentally are always in demand.

In many cases, however, these faults are directly due to the wrong preparing methods being employed, either in the crabbing or the scouring of the cloths.

A particularly common fault which occurs during the dyeing of the fabric and for which the dyer is often held responsible, is that of "cracking" of the cloth, this fault being particularly prone to develop in such cloths as poplin and repp fabrics, in both botany and cross-bred qualities. No doubt the open construction of these fabrics, with their simple cross-over weave and very light weight, is greatly responsible for the occurrence of this fault.

It often happens that these goods, when examined after the crabbing and scouring operations have been carried out, are found to be quite all right, but immediately the dyeing operation has been carried out the goods are found to be "cracked" and the dyer is consequently held responsible.

Strictly speaking, there are two forms of cracking which can appear in fabrics of these types, first, the wool fibers of the warp or weft of the cloth actually bursts, due to felting taking place from varying causes, and second, the weave or design of the cloth is disarranged or pushed aside as in the accompanying sketch. In spite of many conflicting opinions to the contrary, this fault is directly due to the wrong crabbing methods being employed in the preparation of the cloth.

Even today many concerns still carry out this vital operation of crabbing in a haphazard fashion, and very little information exists as to the correct processes which should be applied in this operation to certain individual types of cloths. The lighter types of dress goods such as those already mentioned should be crabbed on the two bowl crabbing machine. This is generally equipped with steaming apparatus, this method being far in advance of the old tap steaming process, which is still in use with many concerns today, a process in which the goods have to be steamed separately after the actual crabbing operation has been carried out.

It should be clear that if the goods are examined after the initial operations have been carried out and the occurrence of "cracking" is not apparent, then the dyeing operation has some effect upon the fabric which causes or leads to this fault taking place. This is not, however, to say, that the dyeing operation is at fault, or the dyer is to blame, as this fault is incidentally directly due to the crabbing process.

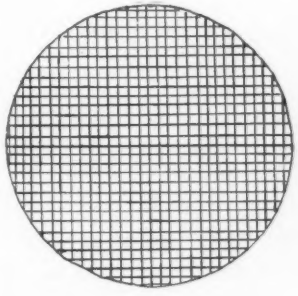

Fig. 1.
Showing appearance of fibers in steamed piece after dyeing.

Fig. 2.
Showing distorted effect of fibers after dyeing has taken place in unsteamed piece owing to uneven tension of "set"

The primary objects in the crabbing of any textile fabrics, are to gain luster, and insure the perfect setting of the cloth, thus eliminating, cockling, cracking, running marks, uneven tension in the piece, etc. Although a piece may upon examination be perfectly set after the crabbing and scouring operations have been carried out, this is not to say that the fabric is permanently set, and this is the key to the whole problem.

Where "cracking" of the fabric takes place, in either instances or forms of this fault, after the dyeing operation has been carried out, this is due to the fabric not being thoroughly or permanently set.

As the crabbing of any class of textile fabrics is carried out by running the cloth tightly and evenly around the crabbing rollers in the bowls of the machine under tension, and allowing the pieces to revolve in the boiling liquor. As in the case of the lighter types of dress fab-

rics, this operation is generally carried out with skill and care, and both the management and the dyer are annoyed and at a loss to know exactly what is the cause of the fabric "cracking" during the dyeing operation. The dyer is often deluged with requests not to resort to prolonged boiling of the cloths, or with instructions to give them ample cooling off times, etc.

Yet it should be noted that the temperature of the boiling liquor in the crab bowls, in which the cloths revolve under tension, is not the highest point or temperature which *can* be reached during the setting of the fabric, as many firms still erroneously imagine.

The permanent setting of the fabric and the elimination of this costly and troublesome fault of the fabric cracking, can only be attained by the proper steaming of the cloths after they have passed through the bowls of the crabbing machine. This permanent setting of the fabric is then achieved because the peak temperature is reached during this crabbing or setting process, and no other operation to which the goods are afterwards subjected to, approaches, equals, or passes this temperature.

Obviously the temperature which prevails during the super-heated steaming of the goods, upon the steaming can of the crabbing machine, is much greater than any temperature which is reached during the boiling of the goods in the crabbing bowls of the machine or in the scouring, dyeing, drying and final finishing operations. It will be found that any goods which are steamed in addition to the ordinary crabbing process, are not affected by the dyeing process and thus do not show any signs of the fault of "cracking" appearing in the fabric.

The moral is quite clear, that the temperature obtained during the "setting" of the goods, while they are under tension in respect to both width and length, must be the peak temperature which is obtained in any process that the goods are subjected to in their journey through the works.

If the goods were only crabbed in both bowls of the crabbing machine, and *could* be dyed under tension with regard to width and length, although the temperature obtained in the dyeing process might then exceed that of the setting or crabbing operation, there would be no disarranging of the fabric, or bursting of the wool fibers in the manner of felting, or in the sense of cracking being apparent in the fabric. On the other hand there would be, if dyeing of the cloth could be carried out under tension, very little incentive for the goods being subjected to the crabbing or setting process.

It should be noted that the steaming of any fabric, and particularly those under review, has other beneficial effects upon the cloth, as in many cases the dyer is often held responsible for the "matting" or milling up of the fabric during the dyeing process. As this "matting" of the fabric is absolutely fatal in the cases of such goods as poplin and repp cloths, which are always required in a clear or clean cut finish, the subject well merits attention. These cloths in addition very easily mill up owing to the open construction of the fabric, and in the majority of cases boiling, without being prolonged on the part of the dyer, will cause this fault to appear.

Thus steaming of the goods is again a great advantage as it materially assists in the cases of such fabrics in more rapid penetration of the dyeing liquor, and in all cases without prolonged boiling in the bath having to be resorted to, better shades are obtained more quickly and easier. At the same time this has an appreciable effect upon the faults which are directly attributable to the dyeing of the fabric.

Owing to the better and readier penetration of the dyeing liquor, there are far fewer instances of cloths being found, uneven, listed, ended, flat shades, etc., when the dyeing operation has been carried out. Thus it will be appreciated that the steaming of the goods has a direct effect in the elimination of those faults that are due to the setting process, and a beneficial effect with regard to the elimination of those faults in pieces, which *are* attributable to the dyer beyond all doubt.

Chicago Manager

Mr. H. L. Derby, Jr. has been appointed Manager of the Chicago District of the American Cyanamid & Chemical Corporation with headquarters at 20 No. Wacker Drive, Chicago. The district embraces the territory west of the State of Ohio, extending to the Rocky Mountains.

Acquires Important Patent Rights

The Rustless Iron and Steel Corporation, through its subsidiary the Rustless Iron Corporation of America has acquired additional important patent rights. The new patents have been issued by the United States Patent Office to members of the research staff of Alloy Research Corporation, an affiliated research organization, and assigned to that corporation. The Rustless Iron Corporation thereby acquires the exclusive American rights to the inventions.

One of the inventions covers the manufacture of rustless iron or stainless steel from scrap materials of similar composition. A considerable volume of scrap is available in all stainless steel producing and fabricating plants. The Patent Office has granted seventeen distinct claims, including several modifications, for this important process.

The other patent just issued covers the preparation of important raw materials used in the production of alloys, as rustless iron and stainless steel, before charging into an electric furnace. The Patent Office has granted thirteen claims in this patent.

The Rustless Iron Corporation is one of the large producers of chromium and chromium-nickel alloys and the only unit in the trade limiting its production facilities exclusively to these metals.

Technical Notes from Foreign Sources

Spinning of Artificial Silk Under Tension

Dr. O. Faust—Kunst-Seide 14, 362 (1932).—A lecture delivered before a local meeting of the German Society of Cellulose Chemists and Workers. As the contents bear rather directly upon some matters of interest and importance to dyers and finishers of artificial fibers, it is here rather carefully reviewed.

Edmund Thiele was the first to deal seriously with the possibility of spinning artificial silk under tension—actual tension, not simply drawing forth the fiber from the spinneret as it forms. His patents date from 1901 onward, and deal mostly with the process as applied to cupro-silk. His purpose was to make possible the production of much finer filaments than was then possible, by an actual stretching of the fiber while still in the plastic, hardly solid form. It was unavoidable, in a way, that Thiele's work should have been carried out with cupro-silk, since at the time the cupro-silk industry was already quite well developed, while the manufacture of viscose silk was still in its infancy. There was the further advantage, that cupro-silk solidifies to the final fiber much more slowly than does the viscose fiber, and Thiele's efforts therefore were soon quite successful. Much work has been done, since viscose silk began to be an article produced on a large scale, with the purpose of so modifying the mode of generation of the viscose fiber that it would form more slowly in the spinning than it characteristically does. As to viscose, the production of fine fibers has at last been attained, but not solely by the Thiele method of applying stretching tension during generation. With cupro-silk, wide spinnerets, with openings of from 0.5 to 1.0 mm. are employed, and the fiber by stretching can be gotten down to 1.5 deniers; but, with viscose silk, in some cases (Vistra), glass spinnerets with 600 to 1,000 openings of about 0.1 mm. diameter are used; and even, with spinnerets of the noble metals, openings of a diameter of 0.08 mm. at the mouth, and even less within, are used (Travis). In such cases as these, the very fine fibers spun are obviously not to be ascribed to any attenuation of an originally coarse fiber. Certainly, it has long been known that, in spinning viscose silk, a certain amount of take-up, almost a low-grade tension, so to say, is necessary; the viscose cannot simply be spun aimlessly, squirted, that is, into the precipitating bath, to lie there loosely before it is wound out of the bath, but it must be kept on the stretch to a slight extent, simply to avoid mechanical difficulties, entanglements, if nothing more. But such tension, if it is enough to deserve the name, is not sufficient to attenuate the fiber, but only to avoid getting the fiber tangled up in the bath, or to draw it out of the spinnerets at such a rate that no coagulation can take place at the mouth of the spinneret, so as to produce clotted sections of greater thickness on the fiber. Only quite recently, in the Lilienfeld process, has actual spinning under stretching tension been utilized for viscose.

The practical worker, long before our present theories regarding the cellulose micelle, knew that the viscose fiber, exposed to tension during its generation, lost some of its elasticity, and gained tensile strength at the same time. Now, this fact is not explained by the theoretical speculations directed at the subject; rather, it contradicts them. If we assume that the cellulose micelles, in solution, possess definite dimensions, and are cylindrical, or rather rod-like, in shape, the laws of hydrostatics demand that these dissolved entities, as the liquid flows, shall arrange themselves in such a way that they will oppose the least possible resistance to the flow; that is, lengthwise to the direction of the flow. It is in accordance with this idea, that German Patent No. 447,208 (1925) proposes to spin the viscose through conical spinning perforations, the smaller end outward, in order to encourage this parallelization of the micelles. The same purpose has been expressed in other patents.

The author, however, in two previous publications (Ber. 39, 219 (1926), and Cellulose-chemie 8, 41 (1927)), has pointed out that this is not true; that, even with a much greater rate of flow than is ever the case with viscose or cupro-ammonium solutions, a parallelization of the micelles in the direction of flow does not take place. Zocher (Z. f. phys. Chem. 98, 293 (1921)) has definitely proved, by means of the polariscope, that this parallelization does not take place. The author (Faust) has studied the process under ordinary conditions, and also, at the suggestion of I. Katz of Amsterdam, has extended his studies to cases in which the spinning solutions (cupro and viscose) were spun under a pressure of twenty atmospheres per square mm., under which the fiber was formed with a very great rapidity. Even under these extreme conditions, optical examination by polarized light showed the utter absence of parallelism as a prevailing, or more than casually occurring, condition. It is plain that, in aqueous spinning solutions, under the conditions normally prevailing, the arrangement to a parallel disposition does not take place—for simple examination under the polarizing microscope shows that no double refraction exists. We can therefore conclude that the particles of cellulose in aqueous solution do not possess the elongate-cylindrical form which has been assumed without proof, while Ambronn (Coll. Ztsch. passim) has proved their existence in the undissolved state. It seems more probable that, in the dissolved condition, the ultimate particles of cellulose, if in the dissolved condition they can be called micelles, are in such a swollen condition that they are practically incapable of shifting about into the desired relation to the direction of flow of the solution. And it also seems probable that, in the process of solution, the ultimate particles, which

may be called macro-molecules, do not tend to assume the bacilloid (straight-rod) shape, but that, as appears also to be the case with the micelles of caoutchouc, the particles tend to roll up upon themselves in such a way that neither polarized light or photography by means of the X-ray give any information of their condition. These points of view, however, do not appear to be probable, according to the work of Staudinger. The properties of the two substances are not at all the same, e.g., as to elasticity. And yet the swollen cellulose, for example, in the form of the just formed and still strongly swollen fiber, is strongly elastic, practically as much so as in caoutchouc; and, in the stretched condition (i.e., while still under tension, and therefore capable of retraction were the tension removed) double refraction can be observed under polarized light, which condition promptly disappears when the tension is relaxed and the fiber or sheet allowed to retract. But, since the swollen fiber, where the above is true, is definitely in the (unnaturally) swollen condition, whereas caoutchouc is not in this condition, we cannot safely draw any definite conclusions from the facts. The author, however, has in another place pointed out his belief that the regular form of the natural cellulose fiber is due to tension existing in the source-plant while growing, a fact which may be brought into parallel with the tension necessarily applied during the actual spinning of the artificial fiber.

It seems important to notice that it is not through any streamline effect, by forcing the viscose through extremely narrow pre-spinneret tubes, that a lining-up of the micelles in a generally straight-forward direction in respect to the axis of the fiber, takes place, but by exertion of external stretching upon the just formed, gelatinous fiber or filament or film, while still in the plastic state. The consequence of this internal rearrangement is, increased tensile strength, and less elasticity. This rearrangement of the micelles in direction will have, of course, decided influence upon the conduct of the final fiber toward dyestuffs. For one thing, the tension exerted must be continuously the same, so that the degree of rearrangement of the micelles shall be identical in all parts of the lot of fiber, and the structural interspaces, into which the dyestuff is to penetrate, shall be of equal value and equal separation. These points alluded to will indicate why, as has been known for some time, a well-stretched fiber has less affinity for a dyestuff; and it may well be that this, is, at least, one of the reasons why the product of some silk manufacturers has been noted for its liability toward unevenness in dyeing, namely, tension, but non-uniform tension, exerted during the spinning.

It is, of course, true that some sort of orientation of the micelles can be attained by dry-stretching of the spun fiber, though at this stage application of tension is a more perilous procedure, especially since the tension applied must be sufficient to cause an actual "flow" of the fiber; otherwise the slight effect produced disappears when the fiber is wetted out again, as in dyeing.

Thus, a distinction has to be drawn between the effects of the two degrees of tension. The value placed upon it has also shifted from point to point. At first, its purpose was merely to produce a finer filament than the coarse spinnerets used at that time could produce; a task which could easily be carried out with cupro-silk, as before mentioned, for the spinning solution in this process, when precipitated with mild precipitants, especially water, produces a filament which hardens only gradually to its final state. This fact is also true of such fibers, e.g., acetate silk, as can be spun by the dry-spinning process, if the evaporation of the solvent is properly controlled. In either of these cases, the fiber being produced is of so gelatinous a nature at first that very little tension is necessary; it simply has to be merely drawn out to the desired degree of fineness. But in the case of viscose spinning, under tension, a decided tension is now used, much higher in degree than the mere gentle drawing out of the fiber from the spinneret. (The Lilienfeld process is here spoken of particularly), with the before-mentioned result the the micelles are "longitudinalized" in reference to the axis of the filament, which thus becomes stronger and less elastic. The Lilienfeld process employs as a precipitating bath a rather strong sulfuric acid, perhaps about 60%, which, it would be supposed, ought to produce a sudden, almost violent, precipitation of the cellulose into a tough, resistant fiber (resistant to tension, that is). But the truth seems to be, that this instantaneous precipitation of the cellulose takes place only superficially, the fiber, after leaving the spinneret, consisting only of an outer layer of cellulose, and within of slowly precipitating viscose.

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